Listing of Claims

1. (Previously presented) A solid oxide fuel cell for electrochemically reacting a fuel gas with an oxidant gas to produce a DC output voltage, said solid oxide fuel cell comprising:

a layer of ceramic ion conducting electrolyte defining first and second opposing surfaces;

a conductive anode layer positioned at the first surface of said electrolyte layer; and

a conductive cathode layer positioned at the second surface of said electrolyte layer;

wherein said electrolyte layer is disposed between said anode layer and said cathode layer;

wherein said conductive cathode layer comprises a copper-substituted ferrite perovskite material and the copper-substituted ferrite perovskite material is in contact with said electrolyte layer;

wherein said solid oxide fuel cell is operable at temperatures less than about 750 °C.

2. (Previously presented) The fuel cell in accordance with claim 1 wherein the perovskite material includes B-site atoms and copper is present in the perovskite material in an amount of at least 2 atomic percent, based on total amount of B-site atoms present in the perovskite material.

3. (Previously presented) The fuel cell in accordance with claim 1 wherein the perovskite material includes B-site atoms and said copper is present in the copper-substituted ferrite material in an amount of at least about 5 atomic percent, based on total amount of B-site atoms present in the copper-substituted ferrite material.

4. (Original) The fuel cell in accordance with claim 1 wherein the material is a copper-substituted lanthanum ferrite perovskite material.

5. (Original) The fuel cell in accordance with claim 4 wherein the material includes an A-site dopant selected from the group consisting of Mg, Ca, Sr, Ba, Pr, Nd, Sm and combinations thereof.

6. (Original) The fuel cell in accordance with claim 5 wherein the A-site dopant is strontium.

7. (Previously presented) The fuel cell in accordance with claim 5 wherein the A-site dopant is present in the copper-substituted lanthanum ferrite material in an amount of from about 5 atomic percent to about 80 atomic percent, based on total amount of A-site atoms present in the copper-substituted lanthanum ferrite material, and copper is present in the copper-substituted lanthanum ferrite material in an amount of from about 5 atomic percent to about 60 atomic percent, based on total amount of B-site atoms present in the copper-substituted lanthanum ferrite material.

8. (Original) The fuel cell in accordance with claim 5 wherein the copper-substituted lanthanum ferrite material further comprises at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium.

9. (Original) The fuel cell in accordance with claim 1 wherein the copper-substituted ferrite cathode exhibits a polarization resistance of from about 0.03 to about 0.50 Ωcm^2 at 650°C in air.

10. (Original) The fuel cell in accordance with claim 1 wherein the copper-substituted ferrite cathode exhibits a polarization resistance of about 0.06 Ωcm^2 at 650°C in air.

Claims 11-12 (Canceled).

13. (Original) The fuel cell in accordance with claim 1 wherein the copper-substituted ferrite material comprises a layer having a thickness of from about 1 to about 50 microns.

14. (Original) The fuel cell in accordance with claim 1 wherein the copper-substituted ferrite material comprises a layer having a thickness of from about 1 to about 30 microns.

15. (Original) The fuel cell in accordance with claim 1 wherein the copper-substituted ferrite material comprises essentially the entire cathode layer.

16. (Original) The fuel cell in accordance with claim 1 wherein the copper-substituted ferrite material comprises at least about 25% of said cathode layer.

17. (Original) The fuel cell in accordance with claim 1 wherein said cathode layer comprises a substantially homogenous mixture of a copper-substituted ferrite material and a finely-divided form of a second material.

18. (Original) The fuel cell in accordance with claim 1 wherein said cathode layer comprises a perovskite composition having the formula:

$$La_{1-x-x'}\,Sr_xA'_{x'}Cu_yB'_{y'}Fe_{1-y-y'}\,O_3$$

wherein x is from about 0.05 to about 0.6; y is from about 0.05 to about 0.5; x' is from 0 to about 0.5; and y' is from 0 to about 0.4.

19. (Original) The fuel cell in accordance with claim 1, further comprising at least one metallic interconnect.

20. (Previously presented) A solid oxide fuel cell assembly for electrochemically reacting a fuel gas with a flowing oxidant gas to produce a DC output voltage, said assembly comprising a plurality of integral fuel cell units, each unit comprising a layer of ceramic ion conducting electrolyte disposed between a conductive anode layer and a conductive cathode layer, and further comprising a metallic interconnect between the anode layer of a first fuel cell unit and the cathode layer of an adjacent second fuel cell unit;

wherein the cathode layer of at least one of said fuel cells comprises a copper-substituted

ferrite perovskite composition and the copper-substituted ferrite perovskite composition is in contact with said electrolyte layer;

wherein said solid oxide fuel cell is operable at temperatures less than about 750 °C.

21. (Previously presented) The fuel cell assembly in accordance with claim 20 wherein the perovskite composition includes B-site atoms and copper is present in the composition in an amount of at least about 2 atomic percent, based on total amount of B-site atoms present in the material.

22. (Previously presented) The fuel cell assembly in accordance with claim 20 wherein the perovskite composition includes B-site atoms and said copper is present in the copper-substituted ferrite composition in an amount of at least about 5 atomic percent, based on total amount of B-site atoms present in the copper-substituted ferrite composition.

23. (Previously presented) The fuel cell assembly in accordance with claim 20 wherein the composition is a copper-substituted lanthanum ferrite perovskite composition.

24. (Original) The fuel cell assembly in accordance with claim 23 wherein the composition includes an A-site dopant selected from the group consisting of Mg, Ca, Sr, Ba, Pr, Nd, Sm and combinations thereof.

25. (Original) The fuel cell assembly in accordance with claim 24 wherein the A-site dopant is strontium.

26. (Original) The fuel cell assembly in accordance with claim 24 wherein the A-site dopant is present in the copper-substituted lanthanum ferrite composition in an amount of from about 5 atomic percent to about 80 atomic percent, based on total amount of A-site atoms present in the copper-substituted lanthanum ferrite composition, and copper is present in the copper-substituted lanthanum ferrite composition in an amount of from about 5 atomic percent to about 60 atomic percent, based on total amount of B-site atoms present in the copper-substituted lanthanum ferrite composition.

27. (Original) The fuel cell assembly in accordance with claim 24 wherein the copper-substituted lanthanum ferrite composition further comprises at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum, and chromium.

28. (Original) The fuel cell assembly in accordance with claim 20 wherein the copper-substituted ferrite cathode exhibits a polarization resistance of from about 0.03 to about 0.50 Ωcm^2 at 650°C in air.

29. (Original) The fuel cell assembly in accordance with claim 20 wherein the copper-substituted ferrite cathode exhibits a polarization resistance of about 0.06 Ωcm^2 at 650°C in air.

Claims 30-31 (Canceled).

32. (Original) The fuel cell assembly in accordance with claim 20 wherein the copper-substituted ferrite composition comprises a layer having a thickness of from about 1 to about 50 microns.

33. (Original) The fuel cell assembly in accordance with claim 20 wherein the copper-substituted ferrite composition comprises a layer having a thickness of from about 1 to about 30 microns.

34. (Original) The fuel cell assembly in accordance with claim 20 wherein the copper-substituted ferrite composition comprises essentially the entire cathode layer.

35. (Original) The fuel cell assembly in accordance with claim 20 wherein the copper-substituted ferrite composition comprises at least about 25% of said cathode layer.

36. (Original) The fuel cell assembly in accordance with claim 20 wherein said cathode layer comprises a substantially homogenous mixture of a copper-substituted ferrite

composition and a finely-divided form of a second material.

37. (Original) The fuel cell assembly in accordance with claim 20 wherein said cathode layer comprises a perovskite composition having the formula:

$$La_{1-x-x'}Sr_xA'_{x'}Cu_yB'_{y'}Fe_{1-y-y'}O_3$$

wherein x is from about 0.05 to about 0.6; y is from about 0.05 to about 0.5; x' is from 0 to about 0.5; and y' is from 0 to about 0.4.

38. (Previously presented) The fuel cell assembly in accordance with claim 20, further comprising:

a system for passing a gaseous fuel in contact with said anode layers and passing an oxidizing gas in contact with said cathode layers.

Claims 39-95 (Canceled).

96. (Withdrawn – previously presented) A method for producing electrical energy, comprising:

providing a solid oxide fuel cell, the solid oxide fuel cell including a layer of ceramic ion conducting electrolyte defining first and second opposing surfaces; a conductive anode layer positioned at the first surface of said electrolyte layer; and a conductive cathode layer positioned at the second surface of said electrolyte layer; wherein said electrolyte layer is disposed between said anode layer and said cathode layer; wherein said conductive cathode layer comprises a copper-substituted ferrite perovskite material and the copper-substituted ferrite perovskite material is in contact with said electrolyte layer;

causing air or other oxidizing gas to flow in contact with the cathode layer; and

causing a fuel gas to flow in contact with the anode layer to provide electrical energy.

97. (Withdrawn) The method in accordance with claim 96 wherein copper is present in the copper-substituted ferrite perovskite material in an amount of at least about 2 atomic percent.

98. (Withdrawn) The method in accordance with claim 96, further comprising operating

the fuel cell at a temperature of no greater than about 750°C.

99. (Withdrawn) The method in accordance with claim 96 wherein the solid oxide fuel cell further comprises at least one metallic interconnect.

100. (Withdrawn) The fuel cell in accordance with claim 5 wherein the A-site dopant is Mg.

101. (Withdrawn) The fuel cell in accordance with claim 5 wherein the A-site dopant is Ca.

Claim 102 (Canceled).

103. (Withdrawn) The fuel cell in accordance with claim 5 wherein the A-site dopant is Ba.

104. (Withdrawn) The fuel cell in accordance with claim 5 wherein the A-site dopant is Pr.

105. (Withdrawn) The fuel cell in accordance with claim 5 wherein the A-site dopant is Nd.

106. (Withdrawn) The fuel cell in accordance with claim 5 wherein the A-site dopant is Sm.

107. (Withdrawn) The fuel cell in accordance with claim 8 wherein the B-site dopant is nickel.

108. (Withdrawn) The fuel cell in accordance with claim 8 wherein the B-site dopant is cobalt.

109. (Previously presented) The fuel cell in accordance with claim 8 wherein the B-site dopant is manganese.

110. (Withdrawn) The fuel cell in accordance with claim 8 wherein the B-site dopant is aluminum.

111. (Withdrawn) The fuel cell in accordance with claim 8 wherein the B-site dopant is chromium.

112. (Previously presented) The fuel cell in accordance with claim 1 wherein the copper-substituted lanthanum ferrite material further comprises at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium.

113. (Previously presented) The fuel cell in accordance with claim 112 wherein the B-site dopant is manganese.

114. (Previously presented) The fuel cell in accordance with claim 20 wherein the copper-substituted lanthanum ferrite material further comprises at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium.

115. (Previously presented) A solid oxide fuel cell for electrochemically reacting a fuel gas with an oxidant gas to produce a DC output voltage, said solid oxide fuel cell comprising:

a layer of ceramic ion conducting electrolyte defining first and second opposing surfaces;

a conductive anode layer positioned at the first surface of said electrolyte layer; and

a conductive cathode layer positioned at the second surface of said electrolyte layer;

wherein said electrolyte layer is disposed between said anode layer and said cathode layer; and

wherein said conductive cathode layer comprises a copper-substituted lanthanum ferrite perovskite material that includes at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium;

wherein said solid oxide fuel cell is operable at temperatures less than about 750 °C.

116. (Previously presented) The fuel cell in accordance with claim 115 wherein copper is present in the perovskite material in an amount of at least 2 atomic percent, based on total amount of B-site atoms present in the perovskite material.

117. (Previously presented) The fuel cell in accordance with claim 115 wherein said copper is present in the copper-substituted ferrite material in an amount of at least about 5 atomic percent, based on total amount of B-site atoms present in the copper-substituted ferrite material.

118. (Previously presented) The fuel cell in accordance with claim 115 wherein the perovskite material includes an A-site dopant selected from the group consisting of Mg, Ca, Sr, Ba, Pr, Nd, Sm and combinations thereof.

119. (Previously presented) The fuel cell in accordance with claim 118 wherein the A-site dopant is strontium.

120. (Previously presented) The fuel cell in accordance with claim 115 wherein the copper-substituted ferrite cathode exhibits a polarization resistance of from about 0.03 to about 0.50 Ωcm^2 at 650°C in air.

Claim 121 (Canceled).

122. (Previously presented) The fuel cell in accordance with claim 115 wherein the copper-substituted ferrite material comprises a layer having a thickness of from about 1 to about 50 microns.

123. (Previously presented) The fuel cell in accordance with claim 115 wherein the copper-substituted ferrite material comprises a layer having a thickness of from about 1 to about 30 microns.

124. (Previously presented) The fuel cell in accordance with claim 115 wherein the copper-substituted ferrite material comprises essentially the entire cathode layer.

125. (Previously presented) The fuel cell in accordance with claim 115 wherein the copper-substituted ferrite material comprises at least about 25% of said cathode layer.

126. (Previously presented) The fuel cell in accordance with claim 115 wherein said cathode layer comprises a substantially homogenous mixture of a copper-substituted ferrite material and a finely-divided form of a second material.

127. (Previously presented) The fuel cell in accordance with claim 115 wherein said cathode layer comprises a perovskite composition having the formula:

$$La_{1-x-x'}Sr_xA'_{x'}Cu_yB'_{y'}Fe_{1-y-y'}O_3$$

wherein x is from about 0.05 to about 0.6; y is from about 0.05 to about 0.5; x' is from 0 to about 0.5; and y' is from 0 to about 0.4.

128. (Previously presented) A solid oxide fuel cell assembly for electrochemically reacting a fuel gas with a flowing oxidant gas to produce a DC output voltage, said assembly comprising a plurality of integral fuel cell units, each unit comprising a layer of ceramic ion conducting electrolyte disposed between a conductive anode layer and a conductive cathode layer;

wherein the cathode layer of at least one of said fuel cells comprises a copper-substituted ferrite perovskite material that includes at least one B-site dopant selected from the group consisting of nickel, cobalt, manganese, aluminum and chromium;

wherein said solid oxide fuel cell is operable at temperatures less than about 750 °C.

Claim 129 (Canceled).

130. (Previously presented) The fuel cell in accordance with claim 1 wherein the electrolyte layer comprises a yttria-stabilized zirconium oxide.

131. (Previously presented) The solid oxide fuel cell assembly in accordance with claim 20 wherein the electrolyte layer comprises a yttria-stabilized zirconium oxide.

132. (Previously presented) The fuel cell in accordance with claim 115 wherein the electrolyte layer comprises a yttria-stabilized zirconium oxide.